cartridge increases the risk of data loss and can lead to undesirable downtime of the storage system.

SUMMARY OF THE INVENTION

It is an object of the present invention to ameliorate one or more disadvantages of the prior art.

According to one aspect of the present invention there is provided an optical disk drive, comprising: a drive motor for rotating an optical disk mounted thereto, the disk having a plurality of tracks; a light source for projecting a light beam; an optical head having optical elements for focusing the light beam on a surface of the disk; an actuator for transporting said optical head in a radial direction across the surface of the disk; first processing means for receiving a first portion of the light beam reflected off of the surface of the disk and for generating a first signal representative of information recorded on the disk; second processing means for receiving a second portion of the light beam reflected off of the surface of the disk and for generating a second signal representative of track crossings; means for determining a gain value of the second signal; means for establishing and storing a base gain value of the second signal; means for comparing the determined gain value of the second signal with the stored base gain value; means for generating an alert signal if the determined gain value exceeds a predetermined percentage of the base gain value, the alert signal indicative of an excessive buildup of contamination on optical elements in the optical recording device; and means for cleaning at least a portion of said optical head in response to the alert signal.

According to another aspect of the present invention there is provided an apparatus for monitoring a buildup of contamination on optical elements in an optical recording device, comprising: means for generating a tracking error signal indicative of track crossings on an optical disk; means for determining a gain value of the tracking error signal; means for comparing the gain value of the tracking error signal with a predetermined value; means for generating an alert signal if the gain value exceeds the predetermined value, the alert signal indicative of an excessive buildup of contamination on optical elements in the optical recording device; and means for cleaning at least a portion of said optical elements in response to the alert signal.

According to still another aspect of the present invention there is provided a method for monitoring a buildup of contamination on optical elements in an optical recording device, comprising the steps: mounting an unrecorded optical disk in an optical recording device; measuring an initial gain of the tracking error signal; storing the initial gain of the tracking error signal in a memory device as a base gain value; initiating a seek operation on the optical disk mounted in the optical recording device; generating a tracking error signal indicative of track crossings; determining a gain value

of the tracking error signal; comparing the determined gain value with the stored base gain value; generating an alert signal if the determined gain value exceeds a predetermined value relative to the base gain value, the alert signal indicative of an excessive buildup of contamination on optical elements in the optical recording device; and cleaning optical elements in the optical recording device in response to the alert signal.

According to yet another aspect of the present invention there is provided an automated optical storage and retrieval system, comprising: an optical disk drive; a plurality of addressable storage cells for holding a plurality of optical recording disks; an accessor for transporting a selected one of the plurality of optical recording disks between a respective storage cell and said drive; and a library controller interconnected with a host device, said drive and said accessor; said drive having: a drive motor for rotating an optical disk mounted thereto, the disk having a plurality of tracks; an optical system having a light source for projecting a light beam, an optical head having optical elements for focusing the light beam on a surface of the disk and a sensor for detecting light reflected from the surface; an actuator for transporting said optical head in a radial direction across the surface of the disk; and a tracking error signal generator responsive to said sensor for generating a tracking error signal; and said library controller having: means for measuring a gain value of: the tracking error signal; means for comparing a measured gain value of the tracking error signal with a predetermined base gain value; means for generating an alert signal if the gain value of the tracking error signal exceeds a predetermined relative amount of the base gain value, the alert signal indicative of an excessive buildup of contamination on the optical elements in the optical disk drive; and means for cleaning at least a portion of the optical elements in response to the alert signal.

DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

An embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 is a block diagram of an optical disk recorder incorporating the present invention;

Fig. 2 is a block diagram of the optical disk recorder of Fig. 1 incorporated into an automated storage and retrieval environment;

Fig. 3, curves 'A' and 'B' are graphical plots of contamination level within an optical disk recorder versus TES gain, without and with drive cleaning, respectively; and

Fig. 4 is a flow chart of a procedure of the present invention.

An optical recorder 12 with which the present invention may be advantageously employed is shown in Fig. 1. Although the following description refers specifically to a magneto-optical (MO) recording device, the present invention is equally applicable to other optical recording methods, including write once (WORM). An MO disk 130 is removably mounted for rotation on a spindle 131 by a motor 132. An optical head-carrying carriage, generally denoted by numeral 134, is mounted to a frame 135 of the recorder 12 and moves radially across the disk 130. The radial motions of the carriage 134 enable access to any one of a plurality of concentric tracks or circumvolutions of a spiral track for recording and recovering data on and from the disk 130. A linear actuator 136 mounted on the frame 135 radially moves the carriage 134 for enabling track accessing. The recorder 12 is interconnected through a controller 11 to one or more host processors 137 via a cable or bus 116 and 202. Such host processors 137 may be control units, personal computers, large system computers, communication systems, image signal processors, and the like. Attaching circuits 138 provide the logical and electrical connections between the optical recorder 12 and the controller 11.

CLAIMS

1. An optical disk drive, comprising:

a drive motor for rotating an optical disk mounted thereto, the disk having a plurality of tracks;

a light source for projecting a light beam;

an optical head having optical elements for focusing the light beam on a surface of the disk;

an actuator for transporting said optical head in a radial direction across the surface of the disk;

first processing means for receiving a first portion of the light beam reflected off of the surface of the disk and for generating a first signal representative of information recorded on the disk;

second processing means for receiving a second portion of the light beam reflected off of the surface of the disk and for generating a second signal representative of track crossings;

means for determining a gain value of the second signal;

means for establishing and storing a base gain value of the second signal;

means for comparing the determined gain value of the second signal with the stored base gain value;

means for generating an alert signal if the determined gain value exceeds a predetermined percentage of the base gain value, the alert signal indicative of an excessive buildup of contamination on optical elements in the optical recording device; and

means for cleaning at least a portion of said optical head in response to the alert signal.

2. The optical disk drive of claim 1, wherein said second signal is a tracking error signal.

3. The optical disk drive of claim 2, wherein said second processing means comprises a quad-detector optically coupled to receive the second portion of the reflected light.

4. The optical disk drive of claim 1, further comprising a Small Computer Systems Interface (SCSI) interconnecting said optical disk drive with a host device for the exchange of signals therebetween;

said means for generating an alert signal comprising means for transmitting the second signal gain to the host device through the Small Computer Systems Interface, whereby the host device activates said means for cleaning.

5. An apparatus for monitoring a buildup of contamination on optical elements in an optical recording device, comprising:

means for generating a tracking error signal indicative of track crossings on an optical disk;

means for determining a gain value of the tracking error signal;

means for comparing the gain value of the tracking error signal with a predetermined value;

means for generating an alert signal if the gain value exceeds the predetermined value, the alert signal indicative of an excessive buildup of contamination on optical elements in the optical recording device; and

means for cleaning at least a portion of said optical elements in response to the alert signal.

6. The apparatus of claim 5, wherein said means for generating a tracking error signal comprises a quad-detector optically coupled to receive light from a light source and reflected off of a surface of the optical disk.

7. The apparatus of claim 5, further comprising:

a plurality of addressable storage cells for holding a plurality of optical disks;

an accessor for transporting a selected one of the plurality of optical disks between a storage cell and said optical recording device; and

a controller interconnected with said optical recording device and including means for determining and storing a predetermined value of the tracking error signal gain for each of the optical disks.

8. The apparatus of claim 5, further comprising an interface for interconnecting the optical recording device with a host device, said means for generating an alert signal including means for transmitting the tracking error signal gain to the host device through said interface for enabling the host device to activate said means for cleaning.

9. The apparatus of claim 8, wherein said interface comprises a Small Computer Systems Interface (SCSI) device.

10. The apparatus of claim 5, wherein:

said means for determining comprises means for measuring an initial gain value of the tracking error signal of the optical disk when the optical disk is mounted in the optical recording device for the first time; and

said apparatus further comprises memory means for storing the initial gain value as the predetermined value and means for writing the initial gain value to said memory means.

11. The apparatus of claim 10, wherein said memory means comprises the optical disk.

12. The apparatus of claim 10, wherein said memory means comprises a non-volatile memory device.

13. The apparatus of claim 10, wherein said memory means comprises a magnetic disk.

14. A method for monitoring a buildup of contamination on optical elements in an optical recording device, comprising the steps:

mounting an unrecorded optical disk in an optical recording device;

measuring an initial gain of the tracking error signal;

storing the initial gain of the tracking error signal in a memory device as a base gain value;

initiating a seek operation on the optical disk mounted in the optical recording device;

generating a tracking error signal indicative of track crossings;

determining a gain value of the tracking error signal;

comparing the determined gain value with the stored base gain value;

generating an alert signal if the determined gain value exceeds a predetermined value relative to the base gain value, the alert signal indicative of an excessive buildup of contamination on optical elements in the optical recording device; and

cleaning optical elements in the optical recording device in response to the alert signal.

15. The method of claim 14, wherein said cleaning step comprises the step of cleaning optical elements in the optical recording device by a cleaning device mounted therein in response to the alert signal.

16. The method of claim 14, wherein said step of generating an alert signal comprises the step of generating the alert signal if the determined gain value exceeds approximately 110% of the base gain value.

17. The method of claim 14, further comprising the step of transmitting the tracking error signal gain to a host device through a Small Computer Systems Computer (SCSI) device to notify the host device of excessive contamination on the optical elements.

18. An automated optical storage and retrieval system, comprising:

an optical disk drive;

a plurality of addressable storage cells for holding a plurality of optical recording disks;

an accessor for transporting a selected one of the plurality of optical recording disks between a respective storage cell and said drive; and

a library controller interconnected with a host device, said drive and said accessor;

said drive having:

a drive motor for rotating an optical disk mounted thereto, the disk having a plurality of tracks;

an optical system having a light source for projecting a light beam, an optical head having optical elements for focusing the light beam on a surface of the disk and a sensor for detecting light reflected from the surface;

an actuator for transporting said optical head in a radial direction across the surface of the disk; and

a tracking error signal generator responsive to said sensor for generating a tracking error signal; and said library controller having:

means for measuring a gain value of:

the tracking error signal;

means for comparing a measured gain value of the tracking error signal with a predetermined base gain value;

means for generating an alert signal if the gain value of the tracking error signal exceeds a predetermined relative amount of the base gain value, the alert signal indicative of an excessive buildup of contamination on the optical elements in the optical disk drive; and

means for cleaning at least a portion of the optical elements in response to the alert signal.

19. The system of claim 18, further comprising:

means for measuring a base gain value of the tracking error signal of the selected optical recording disk when the disk is unrecorded; and

means for storing the base gain value.

20. The system of claim 19, wherein said means for storing comprises the selected optical recording disk.

21. The system of claim 18, further comprising a Small Computer Systems Interface (SCSI) device interconnecting said library controller with said optical disk drive for the transmission of signals from the optical disk drive to the library controller.

22. The system of claim 18, further comprising a cleaning cartridge held in one of said storage cells.

AN OPTICAL STORAGE DEVICE

ABSTRACT

The present invention provides an apparatus and method for sensing the contamination level in an optical storage device (12) and for issuing a signal when the contamination exceeds a predetermined value relative to a base value. The tracking error signal gain of an optical driver (202) is monitored and compared with a base gain. An alert signal is then generated if the actual measured gain exceeds a predetermined level relative to the base gain, whereupon a cleaning device can be mounted in the storage device (12) and optical elements cleaned.

Fig. 1